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Exotic thin-shell fluid stars with arbitrary compactess

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We propose two models for constant density relativistic perfect-fluid spheres supported by thin shell configurations. These models are obtained from the Schwarzschild constant density star solution: the first via the collapse of the external layers of the fluid into a thin shell by performing a matching with the exterior Schwarzschild solution at a matching radius smaller than the star radius; and the second via the creation of a vacuum bubble inside the star by matching it with an interior Minkowski spacetime. Both models are shown to satisfy both the weak and the strong energy conditions (WEC and SEC) and can have a compactness arbitrarily close to that of a black-hole without developing singularities at the center, thus being exceptions to the Buchdahl limit. We compute the stability regimes of the models proposed and we show that there are combinations of the star radius R and the matching radius R_Σ for which the solutions are stable, the dominant energy condition (DEC) is satisfied, and the radius of the object is smaller than $3M$, implying that these models could be used as models for dark matter or exotic compact objects.

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